What is Grain Merchandising, Hedging and Basis Trading?

Grain Merchandising

Grain merchandising describes the process of buying and selling grain. Agribusiness firms that merchandise grain include grain elevators, shippers, processors and feeders. Grain elevators purchase grain from farmers at harvest time and throughout the next crop year. With respect to corn and soybeans, the crop year spans the period September through August of the following year. Over this same time period elevators will sell the grain to buyers on the next level of the marketing chain. Eventually grain will be purchased for livestock feed or used to create value added products by end users, which will appear on the shelves of our grocery stores. Thus in their role as "middle men", grain merchandisers serve a critical marketing function – buying grain when farmers want to sell, and storing grain until users want to buy it. However, storing grain is an inherently risky business as it leaves merchandisers subject to volatile commodity prices.

Hedging

- Hedging in futures markets provides merchandisers with the main tool to conduct PRICE RISK MANAGEMENT.

- A hedger is a firm that enters the futures market to remove price risk.

- The basic idea behind hedging is to take the opposite position in futures to your actual current or anticipated cash position.

- Merchandisers use two types of hedges:

1) Short Hedge: (To offset cash losses when prices fall)
Merchandisers initially sell futures contracts when buying cash grain. This position is established when a merchandiser anticipates storing grain and is concerned prices will fall before the grain is subsequently sold. The sold or short futures position will be of equal size in terms of quantity of bushels as the bought or long cash position. This type of hedge removes price risk by offsetting losses on the cash position should prices fall. The hedger is left with basis risk, where basis is defined as the difference between the cash and futures price (cash price – futures price).

For example, a grain elevator buys corn at $3.50 per bushel during harvest (October) in the cash market from farmers. By simultaneously selling December futures contracts, which are trading at $3.70 per bushel, a -0.20 DEC (twenty cents under December) **buy basis** is formed. The elevator plans to store the corn for one month, and is concerned that the cash market price for corn will fall over this period. By November, when the elevator sells the bushels, the cash price has fallen to $3.40 per bushel. The elevator sells the corn at the lower cash price and simultaneously buys the futures contracts at $3.60 per bushel. Thus, the $0.10 loss in the elevator's cash position is offset by a $0.10 cent gain the elevator's futures position. Note in this scenario basis remained unchanged over the

period at -0.20 DEC. More often than not relative price changes between cash and futures markets will differ over time, and hence a positive or negative basis change will occur. In the short hedging case an increase in basis will result in a net positive return to the hedge, while conversely a fall in basis will result in a net negative return to the hedge. Hence, the final outcome of the hedge will be subject to unpredictable movements in basis (basis risk). T-Accounts illustrate this example below:

Time	Cash Grain		DEC Futures		Basis
	Buy	Sell	Buy	Sell	
Oct	3.50			3.70	Buy Basis -0.20 DEC
Nov		3.40	3.60		Sell Basis -0.20 DEC
	-0.10		+0.10		0

2) Long Hedge: (To offset cash losses when prices rise)
Merchandisers initially buy futures contracts when selling cash grain – creating a **sell basis** position. This position is established when merchandisers either (a) sell forward cash grain that they don't already own or (b) sell cash grain that is physically stored with the merchandiser but has not yet been priced with farmers. Grain elevators are able to execute such transactions by selling **price later** or **deferred price (DP)** grain, which are the terms given to grain that is owned by elevators under the terms of a price late contract. Under such contracts, a farmer delivers grain to an elevator but does not establish a price with the elevator until a later date chosen by the farmer. Once physical delivery takes place, the elevator takes ownership of the grain and has the right to sell it at any time (before or after it has been priced by the farmer). In case (a) the merchandiser anticipates buying cash grain at a later date to cover forward sale positions. In case (b) the merchandiser anticipates farmers pricing their cash grain at a later date. Under both of these scenarios the merchandiser is concerned prices will rise before the grain is subsequently bought or priced. The bought or long futures position will be of equal size in terms of quantity of bushels as the sold or short cash position. This type of hedge removes price risk by offsetting losses on the cash position should prices rise. The hedger is left with basis risk, where basis is defined as the difference between the cash and futures price (cash price – futures price).

In a similar vein to the previous short hedge example, assume a grain elevator sells forward corn at $3.50 per bushel during December to a buyer for January delivery. By simultaneously buying March futures contracts, which are trading at $3.60 per bushel, a -0.10 MCH (ten cents under March) sell basis is formed. The elevator plans to buy the corn from farmers in one month (January) to deliver on the forward contract, and is concerned that the cash market price for corn will rise over this period. By January, when the elevator is ready to deliver the bushels to the buyer, the cash price has risen to $3.70

per bushel. The elevator buys the corn from the farmer at the higher cash price and simultaneously sells the March futures contracts at $3.80 per bushel. Thus, the $0.20 loss in the elevator's cash position is offset by a $0.20 gain in the elevator's futures position. Note in this scenario basis remained unchanged over the period at -0.10 MCH. As before, more often than not relative price changes between cash and futures markets will differ over time, and hence a positive or negative basis change will occur. In the long hedging case a decrease in basis will result in a net positive return to the hedge, while conversely an increase in basis will result in a net negative return to the hedge. Hence, the final outcome of the hedge will be subject to unpredictable movements in basis (basis risk). T-Accounts illustrate this example below:

Time	Cash Grain		MCH Futures		Basis
	Buy	Sell	Buy	Sell	
Dec		3.50	3.60		Buy Basis -0.10 MCH
Jan	3.70			3.80	Sell Basis -0.10 MCH
	-0.20		+0.20		0

Basis Trading

In the above hedging examples net returns could have been either positively or negatively impacted by unpredictable movements in basis. In reality, grain merchandising firms do not seek to eliminate basis risk, but rather seek to exploit predictable movements in basis over time. For example, grain elevators automatically hedge cash positions with equal but opposite futures positions and trade basis to enhance returns. Elevators prefer to trade basis (buy basis when basis is low and sell basis when basis is high) rather than speculate in price changes, as basis movements are more predictable than price movements. Predictable basis behavior over the course of a crop year may be illustrated in basis charts, which graph basis levels over time and incorporate futures spreads at contract rollover times. This is illustrated at the following website developed at Office for Futures and Options Research (OFOR) University of Illinois http://www.ace.uiuc.edu/ofor/basis.htm
Also, for specific details on how to create basis tables see (The Art of Grain Merchandising Appendix II).

Spreads: Futures spreads measure the price difference between two futures contracts for different maturities. For example, if it is currently January (in calendar time) and March (nearby or nearest to maturity) corn futures are trading at $3.80 while May futures (a more distant delivery maturity date) are trading at $4, the spread is +0.20.

It is imperative to adjust basis levels for spreads as this creates a predictable upward trending basis chart pattern (when spreads are positive) and a predictable downward trending basis chart pattern (when spreads are negative). When futures contracts for different delivery periods (termed market structure) are trading at successively higher prices, spreads between contracts will be positive and the market structure will be at a "**carry**". In other words higher futures prices for later delivery periods provide firms with an incentive to store commodities and sell at higher prices later in the year. Basis levels tend to follow spreads, so when there is a carry market structure basis will tend to increase over time (this phenomenon occurs because of arbitrage opportunities which force cash and futures prices together at delivery time – known as "convergence"). In this environment elevators will have the opportunity to buy grain at low **buy basis** levels and later sell grain at high **sell basis** levels – a marketing strategy known as going **Long-the-Basis**. Under this strategy firms storing hedged grain (against nearby contracts) will earn the spread (increases returns) as hedged positions are rolled into later maturing contracts (e.g. see example 1b below).

The theory of storage or cost-of-carry model suggests that the returns to this type of storage/marketing strategy should be approximated by the cost of carrying grain over time. In other words gains from storing hedged grain over time should be cancelled out by the physical and opportunity costs of storing grain. Physical costs of storing grain include warehousing, insurance and shrinkage, while opportunity cost comprises the forgone income that could have been earned by selling grain immediately and investing the proceeds (investment or holding period would equate to storage period) at the current bank interest rate. In reality commodities like corn and soybeans in certain market locations can often earn storage returns (made up of basis change) far in excess of the cost of storing grain. This is because (a) production in these markets is highly seasonal, occurring at an annual harvest-time and (b) because local supply and demand shocks impact basis levels across geographically diverse local grain markets, and costs of storing grain differ across market locations. Note for commodities like gold, where the cash market is not segmented into spatially separate market locations, production and consumption are not seasonal in nature and storage costs reflect only interest rates or opportunity costs, cash-and-carry arbitrage ensures that futures price spreads and basis levels are closely approximated by the cost of storing gold over time. Futures prices for investment commodities (e.g. gold, silver etc.), whose primary use is for investment purposes follow cost-of-carry model theory, while the cost-of-carry model only loosely explains futures price behavior for consumption commodities (e.g. corn and soybeans), which are characterized by seasonal production with many spatially diverse cash markets each influenced by local supply and demand conditions.

In sum, basis trading is based upon the assumption that basis patterns may be identified across crop years using (a) current market structure (spreads) and (b) historical basis charts for a given market location. Once discernable basis trends for a given market location have been identified merchandisers can capture changes in basis to enhance margins. "Basis Trader" game simulates this basis behavior using historical futures and cash prices for corn, soybeans and wheat across a number of different market locations.

1a) Long-the-Basis:

Under this strategy elevators will initially establish a low **buy basis** and later sell grain at a higher **sell basis**. Higher margins will be generated using this strategy as long as the (predictable) change in basis is greater than storage costs in dollar terms. To earn higher margins basis will increase or **strengthen** from period one (when buy basis is established) to period two (when sell basis is established).

For example, a grain elevator buys corn at $3.50 per bushel during harvest (October) in the cash market from farmers. By simultaneously selling December futures contracts, which are trading at $3.70 per bushel, a -0.20 DEC (twenty cents under December) buy basis is formed. If the corn is stored for one month and then sold in November at a cash price of $3.40 per bushel, the elevator creates a sell basis of -0.10 DEC (ten cents under December) by buying back the futures contracts at this time for a price of $3.50 per bushel. The gross profit margin of $0.10 on the bushels is determined by relative price changes in the cash and futures markets – or in merchandising terminology by change in basis. T-Accounts illustrate this example below:

Time	Cash Grain		DEC Futures		Basis
	Buy	Sell	Buy	Sell	
Oct	3.50			3.70	Buy Basis -0.20 DEC
Nov		3.40	3.50		Sell Basis -0.10 DEC
	-0.10		+0.20		+0.10

Gross Margin = 10 cents

(Note that the cash position contributes -10 cents and the December futures position +20 cents to Gross Margin, and that the change in basis is equivalent to Gross Margin.)

Cost-of-carry (costs associated with storing grain over the period) is calculated:

$3.55	X	10%	X	30	÷	360	=	3 cents
Estimated Opportunity Price		Real Interest		# of Days				Cost of Carry

ESTIMATED OPPORTUNITY PRICE = Estimated cash sale value of the position at the time of its purchase. In the example we assume 5 cents per bushel back-to-back elevation or handling margin. This is the margin earned by an elevator for providing the services of a "middle man" (the elevator could immediately sell the grain it had just purchased), and its value can be chosen at the beginning of a "Basis Trader" game.

REAL INTEREST RATE = Bank interest loan rate +2% to cover miscellaneous expenses (shrink, insurance, etc.) The interest rate can be chosen at the beginning of a "Basis Trader" game.

NUMBER OF DAYS = Number of days grain is owned. 360 days represents Bank Year.

COST OF CARRY = Cents Per bushel cost of owning grain. "Basis Trader" game graphs an upward sloping cost-of-carry line on the Basis Chart Window (reflecting increased storage costs in cents per bushel for each week from harvest-time). Note that in the game a player can set a VALUE LINE (which represents the net margin that could be earned at any point in time on grain stored from harvest) at any level above the cost-of-carry line. Thus if the value line is set at 20 cents, anytime the sell basis reaches the value line, a net margin of 20 cents per bushel would be earned on grain carried out of harvest. The value line is thus a graphical tool to help the player gauge when in calendar time certain net margins were available historically, and are now available in current year game play.

After accounting for storage costs or cost-of-carry, net margin earned through merchandising is:

Net Margin = Gross Margin – Cost-of-carry

Net Margin = 7 cents

Thus is the example the elevator earned an additional 2 cents per bushel by basis trading or merchandising as opposed to simply buying grain and immediately selling it (5 cents handling margin).

1b) <u>Long-the-Basis with spreads:</u>
Under this strategy elevators will again initially establish a low **buy basis** and later sell grain at a higher **sell basis**. However, in this case grain is stored for a long period of time, and so hedged positions (buy basis positions) initially established against the nearby contract will have to be rolled or **spread** into deferred maturity contracts as the nearby contract approaches maturity. Recall **spread** is defined as the price of a deferred contract less the price of a nearby contract. The number of times a position is spread depends upon length of storage period and the numbers of times nearby contracts reach their maturity dates. Elevators typically prefer to hedge in nearby contracts as they are uncertain as to when grain will be sold, and buyers of grain typically hold long hedge positions in nearby contracts. Thus when elevators sell grain to buyers nearby hedged positions can be unwound by **exchanging physicals** (whereby nearby contracts are exchanged between buyers and sellers of grain, cancelling out or offsetting futures

positions). It is important to note that spreads can be executed at any point in time and the larger the price differential (spread value) between two contracts of different maturities, the greater the contribution to margins. In a long-the-basis situation elevators will look for large carry (positive) spreads to enhance margins. Once the spread has been executed by simultaneously buying the nearby contract and selling the deferred contract, the spread is locked in, and the price differential between buying and selling adds to margin. Higher margins will be generated using this strategy as long as the (predictable) change in basis and the spread contribution is greater than storage costs in dollar terms.

For example, a grain elevator buys corn at $3.50 per bushel during harvest (October) in the cash market from farmers. By simultaneously selling December futures contracts, which are trading at $3.70 per bushel, a -0.20 DEC (twenty cents under December) buy basis is formed. If the corn is stored for two months and then sold in December at a point in time beyond the December futures maturity date, the elevator will have to at some point prior to December maturity buy back the December futures contracts and simultaneously sell March futures. In reality, elevators, in order to avoid physical delivery obligations never carry maturing futures positions into the contract maturity month. In our example, this would mean the December futures position would be spread to a March futures position before the first trading day in December. Let's assume the elevator spreads the position in late November when December futures contracts are trading at $3.80 and March futures contracts are trading at $4.10 per bushel. In this case the spread would be defined as a +0.30 MCH carry spread. In basis math terms this carry spread is subtracted from the initial -0.20 DEC buy basis to create an **adjusted buy basis** of -0.50 March. Finally, let's assume that the grain is sold in December at a cash price of $3.40 per bushel, and the elevator creates a sell basis of -0.10 MCH (ten cents under March) by buying back the March futures contracts at this time for a price of $3.50 per bushel. The gross profit margin of $0.40 on the bushels is determined by the spread and by change in basis. T-Accounts illustrate this example below:

Time	Cash Grain		DEC futures		MCH futures		Basis
	Buy	Sell	Buy	Sell	Buy	Sell	
Oct	3.50			3.70			Buy Basis -0.20 DEC
Nov			3.80			4.10	+0.30 spread ABB -0.50 MCH
Dec		3.40			3.50		Sell Basis -0.10 MCH

	-0.10	-0.10	+0.60	+0.40

Gross Margin = 40 cents

(Note that the cash position contributes -10 cents, December futures position -10 cents, and March futures 60 cents to Gross Margin, and that the change in basis adjusted for the spread is equivalent to Gross Margin.)

Cost-of-carry (costs associated with storing grain over the period) is calculated:

$3.55	X	10%	X	60	÷	360	=	6 cents
Estimated Opportunity Price		Real Interest		# of Days				Cost of Carry

Net Margin = Gross Margin – Cost-of-carry
Net Margin = 34 cents

2a) Short-the-Basis:
Under this strategy elevators will initially establish a high **sell basis** and later buy grain at a lower **buy basis**. Higher margins will be generated using this strategy as long as the (predictable) decreasing change in basis materializes. This type of strategy is particularly appealing late in the crop year when market spreads are often **inverted** (deferred contract prices are less than nearby contract prices). In this situation there will be a natural tendency for basis to decrease over time. Also, this strategy does not incur storage costs, but instead the elevator (under some circumstances) earns interest on money generated from the initial cash grain sale. A natural question that arises is: How can elevators initially sell grain (to form the sell basis) that they don't own? Recall from our earlier discussion of long hedging that this may be accomplished in two ways: (1) the elevator forward contracts to deliver grain at some later date to a buyer; (2) the elevator sells grain that is physically stored under the terms of a **price later** or **deferred payment (DP)** contract. In the first case, the forward contract establishes a cash sales price with a buyer, but because physical delivery does not occur until a later date the elevator is able to buy cash grain (from farmers) sometime after the initial sale but before grain is actually delivered. In this way a sell basis is formed in period one by buying futures to hedge the forward cash sale. Then in period two cash grain is bought to deliver on the forward contract, and the futures position sold to form the subsequent buy basis. Forward contracting is not supported as a feasible strategy in the current version of "Basis Trader" game. In the second case, grain that is delivered to the elevator by farmers under a price later contract is not priced at the time of delivery. Instead the grain is stored at the elevator (who has physical ownership of the grain) and the farmer chooses a later date to price the grain (presumably when grain is at a higher price). However, this type of marketing contract allows the elevator to sell cash grain to a buyer in period one (after the

farmer delivers) and simultaneously buy futures to establish an initial sell basis. In this case grain is immediately delivered to the buyer and the elevator is able to earn interest on the cash receipts from the sale. When the farmer chooses to price the grain at a later date in period two (which is obviously equivalent to the elevator buying the cash grain), the elevator eliminates the hedge by selling futures contracts and establishes the buy basis. Short-the-basis strategy using price later contracts is supported by "Basis Trader" game. In either case the elevator will generate higher margins as long as basis decreases or **weakens** from period one to period two.

For example, a grain elevator sells price later corn at $3.50 per bushel during May in the cash market to a buyer. By simultaneously buying July futures contracts, which are trading at $3.40 per bushel, a +0.10 JUL (ten cents over July) sell basis is formed. If the corn is priced one month later (June) by farmers at a cash price of $3.55 per bushel, the elevator creates a buy basis of -0.20 JUL (twenty cents under July) by selling back the July futures contracts at this time for a price of $3.75 per bushel. The profit margin of $0.30 on the bushels is determined by relative price changes in the cash and futures markets – or in merchandising terminology by change in basis. T-Accounts illustrate this example below:

Time	Cash Grain		JUL Futures		Basis
	Buy	Sell	Buy	Sell	
May		3.50	3.40		Sell Basis +0.10 JUL
June	3.55			3.75	Buy Basis -0.20 JUL
	-0.05		+0.35		+0.30

Net Margin = 30 cents

In reality short-the-basis positions established using price later contracts will also earn fees and interest for the elevator. Fees are charged to farmers for storing grain under the terms of the contract, and interest may be earned on grain sold in period one of the hedging process. If it is assumed that fees are charged at a rate of 5 cents/month and interest accumulates at the rate of 3 cents per month (as in the long-the-basis examples above), margins must be adjusted to account for these factors. In basis math terms, the original sell basis is adjusted upwards to account for fees and interest. Thus in the current example one months fees and interest will create and **adjusted sell basis** of +0.18 JUL and the resulting net margin will be 38 cents per bushel. T-Accounts illustrate this example below:

Time	Cash Grain		JUL Futures		Basis
	Buy	Sell	Buy	Sell	
May		3.50	3.40		Sell Basis +0.10 JUL Fees and interest of 8 cents ASB +0.18 JUL
June	3.55			3.75	Buy Basis -0.20 JUL
	-0.05		+0.35		+0.38

Net Margin = 38 cents

(30 cents comes from cash and futures price changes and 8 cents from fees and interest)

"Basis Trader" game assumes price later contract fees are charged at rate equivalent to the cost-of-carry. Fees are charged beginning in the week of farmer delivery and ending in the week that the farmer prices the grain. It is further assumed that no additional interest is earned on short-the-basis positions.

2b) Short-the-Basis with spreads:

In a similar vein to long-the-basis with spreads elevators will have to spread hedged positions to deferred futures contracts as nearby contracts reach maturity. Thus if short-the-basis positions are held for periods of time longer than that covered by the initial futures contract, subsequent spreads will add or subtract from margins. Unlike long-the-basis positions, margins will be enhanced by negative (inverted) spreads while carry spreads will result in lower margins. As in the long-the-basis case once the spread is set or executed the resulting price differential is locked in and will adjust margins accordingly. An inverted spread will adjust the sell basis to a higher level while a carry spread will result in a lower adjusted sell basis.

For example, again assume a grain elevator sells price later corn at $3.50 per bushel during May in the cash market to a buyer. By simultaneously buying July futures contracts, which are trading at $3.40 per bushel, a +0.10 JUL (ten cents over July) sell basis is formed. If corn is not priced by farmers until July the sell basis must be spread to September futures. Let's assume the elevator spreads the futures position at the end of June when July futures are trading at $3.30 and September futures are trading at $3.00 per bushel. The spread transaction (simultaneous sale of July futures and purchase of September futures) will result in an adjusted sell basis of +0.40 SEP. If farmers

eventually price (sell) cash grain to the elevator under the price later contract in July at a price of $3.10, and the elevator sells September futures at this same point in time at a price of $3.05, a +0.05 buy basis will be established. After further adjusting the original sell basis for fees and interest of 16 cents (8 cents per month) to +0.56 SEP, the elevator's overall margin from the transactions will be 51 cents. T-Accounts illustrate this example below:

Time	Cash Grain		JUL futures		SEP futures		Basis
	Buy	Sell	Buy	Sell	Buy	Sell	
May		3.50	3.40				Sell Basis +0.10 JUL
June				3.30	3.00		-0.30 spread ASB +0.40 SEP Fees and interest of 16 cents ASB +0.56 SEP
July	3.10					3.05	Buy Basis +0.05 SEP
	+0.40		-0.10		+0.05		+0.51

Net Margin = 51 cents
(35 cents comes from cash and futures price changes and 16 cents from fees and interest)

References:

Lorton S., and D. White. 2006. "The Art of Grain Merchandising" Silver Edition. Stipes Publishing.